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University of Maine.

Maine Agricultural Experiment Station

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FIELD EXPERIMENTS IN 1915.

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ORONO, MAINE.

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BULLETIN 246.

FIELD EXPERIMENTS.

Reported by Chas. D. Woods.

The work of investigation at the two experiment station farms (Aroostook Farm, Presque Isle, and Highmoor Farm, Monmouth) is planned by the Director, the Biologists, the Plant Pathologist and the Entomologist. The results of the more scientific phases of the studies are reported from time to time in the bulletins, but it always happens that there are results obtained that lie somewhat outside of the lines of work of any of the Station specialists. Some of the more popular and practical results are here reported. The carrying out of these experiments and the taking of the requisite notes devolved upon different members of the Staff. In general the field work was carried out under the direction of the farm superintendents.

It is planned to report the more scientific aspects of the oat breeding investigations in a bulletin to be published later in the present year.

Drawing Conclusions from Field Experiments.

Field experiments at the best are somewhat uncertain because there are so many factors of soil, temperature, rainfall, and the like, that affect the results which are beyond the control of the experimenter. For this reason it is always planned at this Station to carry the same experiment under as nearly as possible the same conditions through a series of years before attempting to draw any very definite conclusions. The results here reported should be considered more in the light of reports of progress than of completed studies. It may happen that the teaching that a single year's results seem to warrant may be reversed by the repetition of the experiment in other years under different climatic or other conditions.

Fertilizer Experiments on Apple Trees at Highmoor Farm.

As it is pretty generally known, when the State purchased Highmoor Farm it had something over 3,500 apple trees upon it. These trees were about twenty-five years old, but for the most part had been completely neglected, as regards pruning, fertilization, culture and spraying. The first season that the Station had the farm the orchards were plowed, cultivated and sprayed. Pruning was begun and has been continued until at the present time the orchards are in pretty fair shape. It was, of course, not desirable or practical to thin the trees out at the start to where they should be at the end, but the pruning while rather severe each year has been gradually decreased in amount.

The orchards were annually fertilized at the rate of 1,000 pounds per acre of a commercial fertilizer carrying 4 per cent of nitrogen, 8 per cent of available phosphoric acid and 7 per cent potash. At the end of the third year the orchards had so far responded that they gave a good crop and since that time fertilizer experiments have been carried on in various portions of the orchards, as follows:

The use of highly nitrogenous fertilizers has been advocated as a means of forcing trees into bearing and in some parts of the State has been tried with results that seemed to be gratifying. This method was first suggested by Doctor Fisher of Massachusetts and was tried by the Station several years ago in cooperative work with Mr. Pope in his orchard at Manchester without very decisive results. At Highmoor Farm a row of 32 Baldwin trees was divided into three sections. The trees were treated alike so far as the application of standard fertilizer was concerned, but 10 of the trees at each end of the row received in addition nitrate of soda at the rate of 100 pounds per acre. Also the Baldwin orchard was divided into two parts so that part of it received the usual treatment and in addition received 100 pounds of nitrate of soda per acre per year.

Exact records of yields and measurements of growth have been taken since the experiment was begun. No differences that could be attributed to the additional nitrogen in the fertilizer have been noticed. It may be that when at the end of a period of years the data are carefully analyzed, results may be found that are not noticeable from general observations. The experiment will be continued in 1916.

In experiments carried out at the New York State Experiment Station it has been found that with their deep clay soils well suited to apple tree growth and apple bearing, there is no effect from the use of fertilizers either upon the growth of young trees, the wood growth on matured trees, or in the amount, coloring, or size of the fruit. To see if anything like this would hold with Maine conditions, particularly with the rather shallow soil and with the stubborn subsoil upon Highmoor Farm, an experiment was begun in 1912. It is to be remembered that the orchard had been cultivated and fertilized for the three preceding years and brought into good condition. About 400 trees were divided into three plots containing 12 rows extending clear across the large No. 1, Ben Davis orchard. Plot A (rows 1 to 4) has received no fertilizer since 1912. Plot B (rows 5 to 8) has received annually since 1912, 500 pounds per acre of a fertilizer carrying 4 per cent of nitrogen, 8 per cent of available phosphoric acid and 7 per cent of potash. Plot C (rows 9 to 12) has received annually since 1912, 1,000 pounds per acre of a commercial fertilizer carrying 4 per cent of nitrogen, 8 per cent of available phosphoric acid and 7 per cent of potash.

Careful records of growth shown by measure, and of yields of fruit as shown by weight, are made of all of the trees in the orchards at Highmoor Farm. No person examining the twelve rows of apple trees, part of which have been fully fertilized, part partially fertilized and part not fertilized at all for the past three years, could detect differences whereby he would be able to pick out the treated from the untreated rows.

Each tree occupies 25x25 ft. or 625 sq. ft. This is about 70 (69.5) trees per acre. At the rate of 1,000 lbs. per acre this is 14.4 lbs. per tree. Fertilizer at $40 per ton costs 2 cents a pound, making a total cost of 28.8 cents per tree, not allowing for the cost of application.

The crop on this orchard was too small in 1913 to give results that could have any meaning on the apple bearing of the trees. In 1914 and in 1915 there were fair crops and while from observation no differences were apparent, the actual yields of fruit were larger on the fertilized plots. The yields are given in the table that follows, but it will apparently be necessary to wait a number of years before decisive results are obtained. The yields for 1915 show consistent increase with the amount of fertilizer applied.

Orchard Fertilizer Experiment
Yields of Apples in Pounds Per Tree.

PLOT NO.	1914		1915		2-year average yield per tree.—Lbs.
	No. trees.	Average yield per tree.—Lbs.	No. trees	Average yield per tree.—Lbs.	
6A	132	172.8	132	121.1	147.0
6B	129	158.8	130	131.8	145.3
6C	123	194.2	124	157.4	175.8

It is to be remembered that in all of these experiments nothing has been grown upon the land except apple trees and apples. An orchard cover crop of rye is sown in the fall, is plowed under early in the spring, and the land is kept cultivated until well into August when the cover crop is again sown. The plant food stored up in the wood growth and that which has been removed in the apple crop has been taken from the soil, but beyond that the soil has not been made to pay tribute to any other crop.

This experiment is to be continued for many years, or until decisive results are obtained and the unfertilized rows show evidence of need of plant food.

ACID PHOSPHATE AND FLORIDA ROCK AS FERTILIZER FOR OATS.

Shortly before planting time in the spring of 1915 the Station was asked to test the efficiency of raw phosphate on Aroostook Farm. The experiments for the year had already been planned and the land remaining was not very suitable for experimental purposes. However, it was decided to make a preliminary test of acid phosphate and raw ground Florida rock, using oats as the test crop.

Four one-half acre plots were laid out on as even a piece of ground as could be obtained. The plots were crossed by a small runway in which there was some water shortly before planting. Even at the time of planting a strip about 50 feet wide in each plot was quite wet. Over this area the stand was quite poor and the yield was undoubtedly greatly affected. However, since the conditions were practically the same in each plot, the results are comparable one with another. The absolute yield is lower than that obtained on more favorable soil.

The land had been plowed the preceding fall. In order to insure a supply of nitrogen, a good coating of manure was applied to the two acres in the spring and the land plowed again.

All plots were seeded with Prosperity oats using 3 bushels to the acre. Owing to the pressure of other work it was found impossible to thresh the grain from each plot separately. Instead the total weight of the unthreshed grain from each plot was recorded. In this way a very good estimate of the yield of grain can be obtained.

Of the 4 plots, the first received no commercial fertilizer at all. The second plot received 150 pounds of a 16 per cent acid phosphate. This is equivalent to about 48 pounds of *available* phosphoric acid per acre. The third plot received finely ground Florida rock phosphate at the rate of 500 pounds per acre. This raw rock analyzed about 31.45 per cent of total phosphoric acid, making the application of *total* phosphoric acid about 150 pounds per acre. The fourth plot received a 5-8-7 commercial fertilizer at the rate of 500 pounds per acre.

The first 3 plots yielded at approximately the same rate. The total weight of the straw and grain from these plots was at the rate of about 2,800 pounds per acre. This corresponds with a grain yield of about 40 bushels per acre. The variations between the yields of the different plots were not great enough to be significant. The fourth plot which received the complete fertilizer gave 3,900 pounds of grain and straw per acre. This corresponds to a yield of about 56 bushels of grain. This shows an increase of 16 bushels or 40 per cent over the plots receiving no fertilizer or phosphoric acid alone.

The results of this experiment indicate that phosphoric acid is not a controlling factor in the yield of oats under Aroostook Farm conditions. There was no significant difference between the yield of the control plot and the plots containing either acid phosphate or Florida rock. When a complete fertilizer was used, however, a very significant increase (40 per cent) in the yield occurred. The experiment was not planned in such a way as to indicate whether this latter increase was due to the nitrogen or to the potash.

It is not expected to repeat this experiment in 1916. But it is planned to begin the preliminary cropping of a suitable area for the purpose of establishing a series of plot experiments with fertilizers at Aroostook Farm. Raw phosphates will be used on some of these plots.

COMMERCIAL VARIETIES OF OATS AT AROOSTOOK FARM IN 1915.

A preliminary test of different varieties of oats was carried out on Aroostook Farm in 1914. For several reasons the results obtained in 1914 were not entirely satisfactory. The farm was purchased very late in the fall of 1913 and there was little opportunity to learn anything by observation of the land until planting time was come. Because of everything being new to the staff it was impossible to get the oats planted as early as they should have been. The very loose character of the soil allowed the heavy disk drill used in seeding to put the seed too deeply in the ground. All of these things tended to lower the yields.

In 1915 the work at the Farm was very much better organized and more favorable results were obtained. Fifteen different varieties were grown each in a single half acre plot. These varieties were all sown with a large disk drill. In order to prevent the seed going into the ground too deep the land was rolled before drilling. The seeding was at the rate of 3 bushels per acre.

The yields for the year are given in the table that follows.

Tests of Commercial Varieties of Oats at Aroostook Farm in 1915.

VARIETY.	Grain—Bushels per acre	Straw—Pounds per acre
Early Pearl	73.7	2543
Siberian	70.6	2622
Kherson	67.6	2173
Prosperity	66.7	2504
Silver Mine	64.9	2294
Maine No. 246	62.3	2531
Ligowo	62.1	2294
Gold Rain	61.5	2241
Daubeney	60.8	2420
Banner	55.9	2032
Irish Victor	53.5	2032
Garton No. 5	52.9	2275
Imported Scotch	49.9	1788
Senator	49.9	2734
Swedish Select	49.5	1787
Average	60.1	2285

It will be noted that the two highest yielding varieties were the Early Pearl and the Siberian, 74 and 71 bushels per acre respectively. These two varieties are the latest maturing varieties in our collection. It was supposed that some of the earlier maturing varieties would prove best for Aroostook. For the present year such does not seem to have been the case. It is, however, unsafe to generalize upon the results of one year. The use of early varieties has much to commend it for Aroostook conditions. The earlier varieties mature in time so that harvesting does not interfere with potato digging, while many of the later varieties are not ready to harvest before that time.

The variety which ranked third in this year's test was the Kherson with a yield of 68 bushels. The Kherson is one of the early varieties, maturing about 10 days before the medium varieties. The Daubeney, another early variety, gave 61 bushels per acre. The Kherson is a yellow oat, while the Daubeney is a white. They mature at about the same time.

The Prosperity variety gave 67 bushels per acre. This variety is being used as a farm oat at the present time. It is a very good standard variety, maturing in about 110 days in Aroostook.

The Silver Mine, Gold Rain, Ligowo and Maine No. 246 yielded above 60 bushels per acre. The latter variety is one of our own breeding produced at Highmoor Farm.

The Banner, Irish Victor and Garton No. 5 yielded in the neighborhood of 55 bushels and the remaining varieties, Imported Scotch, Senator and Swedish Select, gave about 50 bushels per acre.

It is expected to continue these experiments in 1916. After the results of several seasons have been obtained, they will undoubtedly indicate which of the more common commercial varieties are best adapted to Aroostook conditions. At the same time efforts are being made to breed new varieties which will be still better adapted to Aroostook conditions. It is clear that there is a need for such varieties, for the yields so far obtained at Aroostook Farm are 10 to 15 bushels per acre less than obtained at Highmoor Farm. It is not believed that these are by any means the maximum that might be expected from well adapted varieties.

COMMERCIAL VARIETIES OF OATS GROWN AT HIGHMOOR FARM IN 1915.

The Maine Agricultural Experiment Station has been conducting tests of commercial varieties of oats at Highmoor Farm since 1910. The detailed results of these tests for the four years 1910 to 1913 inclusive have been published in Bulletin 229. The results of the 1915 tests are now available and show many interesting points.

The method used by the Station in recent variety tests has been to plant four plots of each variety. Each plot contains 1-40 of an acre, making in all 1-10 of an acre devoted to each variety. The four plots of a variety are placed in different parts of the field so that the yield of any one variety is less likely to be affected by differences in soil conditions. The average of the four plots is taken as the yield of a given variety for that year.

For a number of years past as many as 20 or more commercial varieties of oats have been tested each year. Owing to the necessity for testing upon a larger scale a number of new varieties of our own breeding this year, it was necessary to decrease the number of commercial varieties in the test. Eleven different commercial varieties were tested in 1915. The majority of these were chosen because of their good yields in former years. A few, like the Kherson and the Senator, were chosen because they represent distinct types of oats.

The yields with the varieties arranged in order of the 3 year average yields are given in the table that follows.

Yields Per Acre of Commercial Varieties of Oats Tested at Highmoor Farm 1913-1915.

VARIETY.	3-year average Bush.	1915 YIELD.	
		Oats Bush.	Straw Lbs.
Early Pearl	84.6	86.6	3723
Minnesota No. 26	83.5	81.7	3460
Gold Rain	81.2	79.8	3623
Banner	80.3	83.3	3605
Irish Victor	77.0	75.4	3107
Siberian	76.0	77.8	4001
Prosperity	75.0	74.5	3436
Imported Scotch	72.2	64.7	2275
Swedish Select	70.7	68.3	3648
Kherson	67.5	64.8	3105
Senator	64.4	55.8	3237
Average	75.7	73.9	3384

The season of 1915 proved to be very good for oats at Highmoor Farm. The yields were not quite so high as in 1914. Part of this was due to the heavy rains at the time of harvest which injured the grain to some extent. Individual plots yielded at the rate of from 50 to 97 bushels per acre.

The variety showing the highest average yield was the Early Pearl. This averaged to yield at the rate of 87 bushels per acre. Three other varieties yielded 80 bushels per acre or above in 1915. These were the Banner (83 bushels), Minnesota No. 26 (82 bushels), and the Gold Rain (80 bushels). Three of these varieties, the Early Pearl, Minnesota No. 26 and the Gold Rain, have headed the list of commercial varieties for the past 3 years. Last year the Minnesota No. 26 ranked first, the Gold Rain second, and the Early Pearl third. The average yield for the 4 years in which these 3 varieties have been tested are the Early Pearl, 82 bushels; Minnesota No. 26, 79 bushels; Gold Rain, 76 bushels.

These 3 varieties are exceptionally promising for central and southern Maine. So far as yield is concerned there is little to choose between these 3 varieties. Each of them has a medium sized grain, an open head and stiff straw. Even in the severe test this year these varieties lodged very little on our plots. The Early Pearl and the Minnesota No. 26 are white oats, while the Gold Rain is a yellow oat.

On the basis of the 4 year test given in Bulletin 229 the Irish Victor, Imported Scotch and Prosperity were mentioned as the best of the varieties tested up to that time. These 3 varieties yielded well in 1915 but not so well as some of the newer varieties mentioned above. The Irish Victor and Prosperity yielded at the rate of 75 bushels per acre each, while the Imported Scotch gave only 65 bushels.

The Swedish Select yielded 68 bushels per acre. This variety has been quite popular in the State but in our experience it has not had the yielding capacity of many of the other varieties. Further, it has a very weak straw and this year all of the Swedish Select plots lodged very badly.

Of the extra early varieties only the Kherson was grown this year. It yielded 65 bushels per acre. These early oats have never yielded as well as the later varieties at Highmoor Farm.

TESTS OF NEW VARIETIES OF OATS ORIGINATED AT HIGHMOOR FARM.

In addition to the testing of commercial varieties of oats, the Maine Agricultural Experiment Station has been engaged for several years in breeding new varieties of oats that it is hoped will be better adapted to the conditions in this State than any of the existing varieties. The first part of this work was begun in 1910 and has now reached a stage where the results may be given to the public.

In 1910 some 350 individual plants were selected for the variety test plots of that year. In 1911 the seed from each of these plants was sown in a separate garden row. Thus the plants in each row were the offspring of a single plant of the year before. Careful notes were taken on each row, and those which showed the most desirable characters were harvested and threshed, each row by itself. The next year the seed of these most promising rows was planted in small plots of 1-2000 acre. This was necessary on account of the small amount of seed. Notes were again made and only the best plots selected. Thus out of 350 plants originally selected the offspring of 33 were regarded as good enough to continue into 1-40 acre plots in 1913.

In 1914, 31 of these "pure lines" were tested for the second time in duplicate plots. These "pure lines" as they are called are essentially new varieties. Each one of them has been developed from a single plant. Since the oat flower is always self-pollinated each plant in one of these pure lines has the same hereditary constitution as every other plant in that line. For this reason plots of these pure lines are much more even in ripening, in yield, in strength of the straw, and other characters than the ordinary commercial varieties. Further, many of these new varieties are proving superior in yield to any of the commercial varieties tested. Out of the 31 pure lines tested for two years 12 have been judged good enough to be offered to the public.

It is believed that these pure lines represent better seed for central and western Maine than can be obtained in commercial varieties. They are strictly pure bred and come true to type without showing any mixture. Further, they ripen very evenly, which is a very desirable character. With varieties which do not ripen evenly a considerable amount of grain is lost from the shattering of over-ripe plants.

These new varieties have not been given names but bear the number by which they are known in our records prefixed by the word "Maine."

The 12 pure lines mentioned above were again tested in 1915. Each pure line was planted in four 1-40 acre plots placed in different parts of the field. The average of the 4 plots was taken as the yield of that pure line.

The table that follows gives the yields for 1915 and the average yields for the past three years.

Yields per Acre of the New Varieties of Oats Bred at Highmoor Farm.

VARIETY.	3-year average—Bush.	1915 YIELD.	
		Oats—Bush.	Straw—Lbs.
Maine No. 340	88.5	82.8	3654
Maine No. 337	85.9	78.8	3260
Maine No. 230	83.8	77.9	3712
Maine No. 336	83.7	74.0	3548
Maine No. 281	82.6	81.3	3723
Maine No. 351	82.6	77.5	3941
Maine No. 247	82.2	80.2	3322
Maine No. 355	81.6	82.2	3947
Maine No. 286	81.6	77.7	3645
Maine No. 357	80.9	79.7	3675
Maine No. 346	80.7	79.7	3335
Maine No. 307	79.9	76.9	3693
Average	82.8	79.1	3621

It will be noted that the average yields of these pure lines run remarkably even. The highest yielded at the rate of 83 bushels per acre and the lowest at the rate of 74 bushels. This uniformity in yield is probably to be expected when it is remembered that these 12 pure lines represent the best out of 350 originally selected plants. The average for these 12 pure lines is 79 bushels per acre, while the average of 11 of the best commercial varieties obtainable grown under the same conditions was only 73 bushels.

While there is little to choose between these different pure lines, Maine No. 340 has shown some points of superiority. In the first place it is particularly high in yield. In 1914 it averaged 109 bushels per acre. This year it gave 83 bushels. Its average for the three years which it has been tested is 88½ bushels. It is a selection out of the Irish Victor variety and this year gave a yield of over 8 bushels more than the parent variety. Furthermore it has a particularly strong straw and even under the severe conditions of the season of 1915 showed practically no lodging.

This variety, Maine No. 340 was grown as the farm oat at Highmoor Farm in 1915. On the entire 15 acres only one small area showed any lodging. Yet the straw grew quite rank and averaged to yield in the neighborhood of 70 bushels of grain per acre.

Of the remaining varieties, Maine No. 355 yielded 82 bushels; Maine No. 281, 81 bushels; Maine No. 247 and No. 346, 80 bushels each.

A considerable amount of seed from Maine No. 340 is available for distribution this year. The seed from the other pure lines will be placed by the Extension Department of the College of Agriculture so that the varieties may have practical farmers' tests and be maintained pure for seed.

Rate of Seeding Oats in Aroostook County.

It is the prevailing custom in Aroostook County to seed very heavily with oats. Perhaps the majority of the farmers sow from 4 to 6 bushels to the acre. It has been the experience in other parts of the country and even in other parts of the State that this is too much seed for the best results. From 2 to 3 bushels per acre have given the best results in the southern part of the State. However, knowing that Aroostook conditions are quite different from those in the other parts of the State, the Station has not thought it best to make any recommendations for the former region.

In 1914 some preliminary rate of seeding experiments were carried out on Aroostook Farm. The results were reported in Bulletin 236.

Injury to certain of the plots, however, made the interpretation of the results somewhat doubtful. In 1915 these experiments were repeated upon duplicate plots under much more favorable conditions.

Six different rates of seeding were used, ranging from 2 to 7 bushels per acre. Each plot was a half acre in area and the experiment was conducted on as uniform a piece of ground as could be obtained. This land was in potatoes in 1914. The seeding was done with a large disk drill. Owing to the loose texture of the ground the land was rolled before seeding and also immediately afterwards. This prevented too deep seeding.

which sometimes occurs with the use of a heavy disk drill in the loose soil of Aroostook. The seed used was the Prosperity variety and was grown on Aroostook Farm in 1914.

The results of the experiment calculated to acre yields are given in the table which follows.

Rate of Seeding Experiment, 1915.
Yields of grain and straw per acre.

Plot number	RATE OF SEEDING PER ACRE.	Oats—bushels	Straw—pounds
116	8 pecks	56.1	2456
122	8 pecks	50.8	2241
Average		*53.4*	*2349*
117	10 pecks	57.8	1163
123	10 pecks	49.7	1856
Average		*53.8*	*1509*
118	12 pecks	60.3	1990
124	12 pecks	61.5	2743
Average		*60.9*	*2366*
119	14 pecks	67.8	2233
125	14 pecks	66.0	2777
Average		*66.9*	*2505*
120	16 pecks	59.7	2236
126	16 pecks	62.9	2210
Average		*61.3*	*2223*
121	20 pecks	55.9	1844
127	20 pecks	64.9	1955
Average		*60.4*	*1900*

These results are decidedly in favor of the seeding with 14 pecks. They also indicate that when seeded with 3 or 3½ bushels per acre the yield is as great as when seeded with 4 or 5 bushels. The results obtained in 1914 in the main agreed with those of 1915. But, as stated above, they are omitted as there were known errors due to accident in 1914.

From the evidence so far obtained it appears that 3 or 3½ bushels per acre is probably the best rate of seeding for Aroostook conditions when a medium oat like the Prosperity is used. It must be understood, however, that these experiments must be repeated for several years before trustworthy results can be secured. The results obtained this year may not hold good another year when the seasonal conditions are different. The question, for which an answer is sought, is: How much oats should be sown per acre to obtain the best yield in a series of years? Consequently, too much reliance must not be put in the results of any single year It is planned to repeat these experiments in 1916. It is hoped that in time sufficient evidence can be obtained to definitely settle the question as to the proper rate of seeding for Aroostook conditions.

Plant Food in Aroostook Soils.

The shortage of potash in 1915 and its high cost and very limited amount available for 1916 crops makes it necessary to carefully study the fertilizer question from a very different standpoint than at any time in the past. The soils of the older cultivated parts of the State are very uneven in their composition. All types of soil from heavy clay to light sand are jumbled together so that it is not at all unusual to have a half dozen distinct types of soil on the same farm. While the soils of Aroostook County differ considerably and are not uniform, similar to prairie soil, still there is a pretty distinct type of soil that is generally used for the potato crop. On this account chemical analyses throw some light on the soil and fertilizer situation for these fairly similar soils. At different times the Station chemists have examined a total of ten samples of Aroostook soils from the towns of Houlton, Fort Fairfield, Caribou and Presque Isle. The description of the samples and the results of the examination so far as it bears on their content of plant food follow.

Description of Samples.

Except as specially indicated, all of the samples were taken in the fall of the year from newly plowed fields. Samples 549 to 552 were from Aroostook Farm.

Sample No. 549 was taken from the surface soil from a field that had been in grass for three years.

Sample No. 550 was taken from the surface soil from a field that had been in grass for two years, and was in potatoes without any potash in the fertilizer in 1915.

Sample No. 551 was subsoil from the same as the preceding number —550.

Sample No. 552 was taken from a field that had never been plowed and was used for a number of years as pasture. Care was taken to get the sample as free from small roots as possible.

Sample 3403 was taken from a field in Fort Fairfield that had been in grass two years and carried potatoes the year it was sampled. Before the potatoes were planted it had a dressing of stable manure and 1000 pounds of fertilizer to the acre.

Sample 3404 was also from Fort Fairfield from a potato field that had 1,200 pounds of commercial fertilizer the year that it was sampled. It had been in grass for the two preceding years.

Sample 3405 was from Caribou from a field that had been in grass for two years and was in grass the season the sample was taken.

Sample 3406 was also from Caribou from a field that had been cultivated for 13 years and was in oats the year that the samples were taken, potatoes the year before and had been in grass for the two preceding years.

Sample 3407 was from a field in Houlton that had been cultivated for more than 30 years. It was in potatoes for the second consecutive year the season the sample was taken. Fertilizer had been used at the rate of 1,500 pounds to the acre.

Sample 3408 was from a newly cleared field at Houlton, and was unusually light soil for Aroostook County, one part of the field being almost a loam.

Analyses of Aroostook soils by conventional methods showing total nitrogen and potash, and the potash, lime and phosphoric acid that is dissolved out by hot strong hydrochloric acid.

Station number	Total nitrogen	Total potash	Soluble in Strong Acid.		
			Potash	Lime	Phosphoric acid
549	.217	1.45	.310	.176	.211
550	.135	1.70	.354	.198	.151
551	.113	1.46	.313	.190	.172
552	.257	1.57	.369	.308	.262
3403	.281	–	.34	.31	.25
3404	.259	–	.36	.21	.26
3405	.239	–	.28	.11	.26
3406	.238	–	.27	.22	.26
3407	.226	–	.33	.12	.32
3408	.176	–	.35	–	.22

Small as these percentages are, they mean large totals of the constituents in the surface soil of an acre. For instance, the soil to the depth of a foot from which sample 549 was taken would carry about 8,700 pounds of nitrogen, 8,400 pounds acid soluble phosphoric acid and 12,000 pounds acid soluble potash. The amount of these constituents carried off in a single crop of potatoes is insignificant. A crop of 300 bushels of potatoes would remove about 55 pounds of nitrogen, 25 pounds of phosphoric acid and 85 pounds of potash. Added to the top foot of soil these amounts would make only the slightest differences in the percentage composition. Eighty-five pounds of potash in an acre of soil means only .0021 per cent, which is an amount so small that it could not be detected chemically. If it were not that experience and experiment have alike shown that the addition of these comparatively minute amounts of plant food give decisive results—often making the difference between a good crop and a failure—such a treatment would seem absurd. The difference in quality between the plant food added in the fertilizer and that carried by the soil is, for the lack of a better term, called "availability." The plant food of the soil is for the most part unavailable. That of fertilizer is (or should be) available. The subject of soil fertility is a broad one and cannot be here discussed. It is evident that these soils carry potential plant food enough for hundreds of crops. The serious question for 1916 is: "How much of the potash contained in the soil is or can be made available for crops for the coming year?" The data are few and are discussed in a circular of this Station on "Growing Crops Without Potash in 1916." The experiment reported in the next section also throws some light on this question.

EFFECT OF OMITTING POTASH FERTILIZATION UPON THE POTATO CROP.

Since the introduction of potash in commercial fertilizers in the early seventies of the last century, many experiments have been made and many treatises written showing the value of potash in crop growing. The experimental data on growing crops without potash are very few.

Potatoes are the chief cash crop grown in Maine. It is of first importance for the growers to have what facts are available relative to the likelihood of obtaining a crop in 1916 without the application of potash. Foreseeing the possibility that the fertilizers in 1916 would contain very little, if any, potash, the Station began in 1915 at Aroostook Farm, a series of experiments to determine the effect of different amounts of potash. Four different mixtures were used. In each case the fertilizer contains 4 per cent of nitrogen (5 per cent of ammonia), of which one-third was in the form of nitrate of soda, and 8 per cent of available phosphoric acid. The potash varied as follows: On one plot there was none, on another 2 per cent, on another 5 per cent, and on another 8 per cent. The plots were one-half acre each and they were planted in duplicate.

The land had been in grass for two years, one year in oats and the year before that had been in potatoes. No fertilizer had been used since the potato crop of 1911. In each case the fertilizer was applied at the time of planting, at the rate of 1,500 pounds per acre. Other than the amount of potash used, all the plots were treated exactly alike. Lowell Green Mountain potatoes were used for seed.

These experiments were carried out in duplicate on half acre plots Nos. 137 to 140 and 150 to 153.

The fertilizers were sampled just before planting. The results of the analyses are given in the table that follows:

Analyses of Fertilizers Used in No Potash Experiment, 1915.

PLOT NOS.	NITROGEN.				Available phosphoric acid %	Potash %
	As nitrate %	As ammonia %	As organic %	Total %		
137, 150	1.48	1.30	1.63	4.41	8.87	0.00
138, 151	1.35	1.20	1.56	4.11	8.46	2.20
139, 152	1.36	1.16	1.54	4.06	8.08	4.99
140, 153	1.38	1.30	1.52	4.20	8.23	8.13

The planting and harvesting dates are shown in the table.

Dates of Planting and Harvesting.

Plot No.	Date planted	Date harvested	Plot No.	Date planted	Date harvested
137	May 21, 1915	Sept. 30, 1915	150	May 24, 1915	Oct. 6, 1915
138	May 21, 1915	Oct. 1, 1915	151	May 24, 1915	Oct. 6, 1915
139	May 21, 1915	Oct. 1, 1915	152	May 24, 1915	Oct. 6, 1915
140	May 21, 1915	Oct. 1, 1915	153	May 25, 1915	Oct. 6, 1915

All the plots were thoroughly cultivated and sprayed. There was ample rainfall during the growing season. The planting was made after the last heavy rain (May 19) of the spring.

Throughout the growing season the vines on both the no potash plots were a distinctly brighter green and had a thriftier look than on the adjoining plots. The difference was so marked that it attracted much attention from visitors at the farm. The yields are given in the table that follows.

Yields per acre Obtained in No Potash Experiment with Potatoes—1915.

Plot No.	Amount of Potash.	Merchantable.		Culls.	
		Bbls.	Bush.	Bbls.	Bush.
137	None	107	295	4	11
150	None	112	309	6	17
Average		*110*	*302*	*5*	*14*
138	2 per cent	119	327	6	17
151	2 per cent	114	313	7	18
Average		*116*	*320*	*6*	*17*
139	5 per cent	110	304	5	14
152	5 per cent	123	337	4	12
Average		*116*	*320*	*5*	*13*
140	8 per cent	111	304	5	14
153	8 per cent	130	358	5	14
Average		*120*	*331*	*5*	*14*

With the exception of the yield on plot 138, which is unexplainably high, the yields are consistent. In the first series there is apparently no effect from the lack of potash. The yields are about 110 barrels. In the second series the larger amounts of potash (5 per cent and 8 per cent) have very appreciable effects upon the yield. The increase is undoubtedly large enough to be significant and to indicate that potash may be expected to increase the yield of potatoes in Aroostook County.

On the other hand, 110 barrels (302 bushels) per acre is a good yield—considerably above the usual average and nearly double the average in the County in 1915. So far as the results of this one year are concerned, they indicate that a profitable yield of potatoes can be obtained on Aroostook soils without the addition of potash for at least one year. In a few farmers' trials made by the various fertilizer companies, in which no exact records were made, satisfactory results were obtained without the use of potash by all the growers from whom the station has heard. It is planned to repeat this experiment in 1916 and add to it a similar experiment on oats.

The kind of fertilizers for 1916 is discussed in a circular on "Growing Crops Without Potash in 1016" which will be sent to any citizen of Maine on application.

METHOD OF APPLICATION OF FERTILIZER UPON POTATOES AT AROOSTOOK FARM.

It has always been more or less customary in growing potatoes in Maine to apply the fertilizer in the drill or hill at the time of planting. This was largely the practice when farm manures were used in connection with potato growing and has been followed with commercial fertilizers. Although now, when farm manures are used in connection with potatoes they are more likely to be applied broadcast and a smaller amount of fertilizer applied in the drill. There was little question in the minds of practical growers that when 500 to 1000 pounds of fertilizer were applied per acre that it was to the best advantage to apply it in the drill. With the increase up to 1,500 to 2,000 pounds per acre the question has arisen whether it may not be advisable to apply the fertilizer at different times. This led the Station to undertake a series of trials at Aroostook Farm.

In 1914 an experiment was started to extend over a period of years for the purpose of testing the method of applying fertilizer. Something over acre plots were used. Three plots were used in the experiment in 1914. To one plot all of the fertilizer was applied in the planter at planting. To another plot 1,000 pounds of fertilizer was applied at planting and 500 pounds when the potatoes were up. And to a third plot 1,000 pounds was applied broadcast before planting and 500 pounds in the planter at planting. The Lowell Strain of Green Mountain potatoes was used for seed. The crop was well cultivated and sprayed.

The experiment was repeated in 1915 and a plot was added to which all of the fertilizer was applied broadcast before planting. Through a misunderstanding the plot to which 1,000 pounds were added before planting did not have the other 500 pounds applied until the potatoes were up. Plots 133 and 134 were planted to Norcross. Lowell Strain Green Mountain seed was used in the other plots. The yields from these two varieties at Aroostook Farm have been practically identical.

The fertilizer used each year was high grade, carrying 4 per cent nitrogen, 8 per cent of available phosphoric acid and 7 per cent of water soluble potash. One-third of the nitrogen was in the form of nitrate of soda, and the remainder was high grade organic nitrogen. The yields are based upon weighings and not upon measure. The potatoes were clean, without adhering soil.

In potato experiments at Highmoor Farm the Station had found that when there was only a small amount of rainfall following the second application of fertilizer that apparently this added fertilizer was not well utilized. Both seasons, however, at Aroostook Farm there was ample water to dissolve and render the plant food in all of the fertilizer available. It has been estimated that it takes about 6 inches of water to successfully grow a crop of potatoes. The rainfall each year totaled over 12 inches in May, June, July and August.

The dates of planting and the yields for both years are given in the tables that follow.

Dates of Planting and of Harvest in 1914.

Plot No.	Date planted	Date harvested	Plot No.	Date planted	Date harvested
81	May 22, 1914	Oct. 8, 1914	84	May 25, 1914	Oct. 6, 1914
82	May 22, 1914	Oct. 7-8, 1914	85	May 25, 1914	Oct. 6, 1914
83	May 23, 1914	Oct. 7, 1914	86	May 25, 1914	Oct. 2, 1914

Yields per acre Obtained in Method of Applying Fertilizer Experiment—1914.

Plot No.	TREATMENT.	Merchantable		Culls		Total	
		Bbls.	Bush.	Bbls.	Bush.	Bbls.	Bush.
82	All in planter	*	-	-	-	134.4	369
85	All in planter	125.3	344.5	2.1	5.8	127.4	350
	Average	-	-	-	-	*130.9*	*359*
83	1000 lbs. in planter, 500 lbs when up	126.0	346.6	0.7	2.0	126.7	348
86	1000 lbs. in planter, 500 lbs when up	119.1	327.4	1.5	4.3	120.6	331
	Average	*122.5*	*337.0*	*1.1*	*3.1*	*123.6*	*340*
81	1000 lbs. broadcast 500 lbs. in planter	*	-	-	-	120.7	331
84	1000 lbs. broadcast, 500 lbs. in planter	124.7	342.8	1.9	5.3	126.6	348
	Average	-	-	-	-	*123.6*	*340*

*In plots 81 and 82 the small and scabby potatoes were weighed together, and the amount of actual culls is not known.

Dates of Planting and Harvesting, in 1915.

Plot No.	Date planted	Date harvested	Plot No.	Date planted	Date harvested
133	May 20, 1915	Sept. 29, 1915	146	May 24, 1915	Oct. 4, 1915
134	May 20, 1915	Sept. 30, 1915	147	May 24, 1915	Oct. 4, 1915
135	May 21, 1915	Sept. 30, 1915	148	May 24, 1915	Oct. 6, 1915
136	May 21, 1915	Sept. 30, 1915	149	May 24, 1915	Oct. 6, 1915

Yields per acre Obtained in Method of Applying Fertilizer Experiment—1915.

Plot No.	TREATMENT.	MERCHANTABLE		CULLS	
		Bbls.	Bush.	Bbls.	Bush.
133	All in planter	99.8	274.5	7.4	20.4
146	All in planter	117.8	323.9	2.9	7.9
	Average	*108.8*	*299.2*	*5.2*	*14.3*
134	1000 in planter, 500 when up	109.1	300.0	2.3	6.3
147	1000 in planter, 500 when up	117.4	322.8	3.7	10.2
	Average	*113.3*	*311.5*	*3.0*	*8.3*
135	1000 broadcast, 500 when up	98.9	271.9	3.4	9.4
148	1000 broadcast, 5000 when up	119.1	327.5	2.2	6.1
	Average	*109.0*	*299.7*	*2.8*	*7.8*
136	All broadcast	100.3	275.8	2.0	5.5
149	All broadcast	126.2	347.1	3.2	8.8
	Average	*113.3*	*311.5*	*2.6*	*7.2*

The results for the two years are summarized in the following table.

Method of Applying Fertilizer.
Yield in Barrels per Acre.

METHOD.	1914	1915	Average
1500 pounds in planter	130.9	108.8	*119.9*
1000 pounds in planter, 500 pounds when up	123.6	113.3	*118.5*
1000 pounds broadcast, 500 pounds when up	123.4	109.0	*116.2*
1500 pounds broadcast	–	113.3	–

The two years results indicate there is little to choose between the methods. It is planned to repeat this experiment in 1916.

Sulphate of Ammonia Compared with Nitrate of Soda as a Source of Nitrogen in Potato Fertilizers at Aroostook Farm.

A few years ago there was quite a general failure of the crop of potatoes in Aroostook County where a certain brand of fertilizer was used. This fertilizer was analyzed by the Station chemists and found to be high grade. While it was not quite up to its guaranty in some particulars it did carry enough nitrogen, phosphoric acid and potash to more than grow a good crop of potatoes. This fertilizer carried none of its nitrogen in the form of nitrate of soda, but it was all in the form of sulphate of ammonia and high grade organic materials. This led to the stronger reaffirming of the position which the Station had taken relative to the use of nitrate nitrogen on the potato crop. In earlier publications it has been pointed out that the potato makes its demands for nitrogen early in the season and that in the cold, late springs so common in Aroostook County, the crop demands that part of the nitrogen should be immediately available. For this reason the Station has strongly urged that about one-third of the nitrogen in a potato fertilizer be nitrate nitrogen.

In the process of making gas and coke from coal there is developed a large amount of sulphate of ammonia, which in many coke and gas plants is still going to waste. In some plants this now is being conserved and many thousand tons of sulphate of ammonia are thus obtained each year. With the increasing use of high grade organic nitrogen for food of animals, the price of tankage has been going higher and higher year by year. It is, of course, desirable, if it can be done, that as much as possible of this sulphate of ammonia, which is a comparatively cheap source of nitrogen, be used in Maine fertilizers.

Because of these facts, arrangements were made to begin in 1914 a series of experiments to run over a period of several years. The "base" which was used in these goods was made by the wet process, whereby nitrogen from rather low grade goods is made as available as from high grade goods. The available phosphoric acid was furnished in the form of acid phosphate and the potash in the form of sulphate of potassium. The fertilizer was free from chlorides so as to preclude the possibility of the formation of poisonous ammonium chloride. The base carried approximately one-third of the nitrogen that went into the formula. The remainder of the nitrogen was furnished in the form of nitrate of soda and sulphate of ammonia, as indicated in the following plan:

Plot 1. Basal mixture and 2-3 of the nitrogen in form of nitrate of soda.

Plot 2. Basal mixture and 2-3 of the nitrogen in form of sulphate of ammonia.

Plot 3. Basal mixture and 1-3 of the nitrogen in form of nitrate of soda and 1-3 in form of sulphate of ammonia.

Plot 4. Basal mixture and 1-3 of the nitrogen in form of high grade organic and 1-3 in form of nitrate of soda.

Plot 5. Basal mixture and 1-3 of the nitrogen in form of high grade organic and 1-3 in form of sulphate of ammonia.

THE 1914 EXPERIMENT.

There was about an acre in each plot. The Lowell Strain of Green Mountain potato was used for seed in 1914. The fertilizer was applied at the rate of 1500 pounds per acre, and supplied about 60 pounds of nitrogen, 120 pounds of available phosphoric acid and 105 pounds of water soluble potash per acre. Other than the fertilizer used the plots were planted, cultivated, sprayed and cared for in all particulars alike. The fertilizers used in 1914 were not analyzed at the Station.

The plots were planted on the following dates: Plot 87, May 29; Plots 88 and 89, May 30; Plot 90, partly May 30 and finished June 1; Plot 91, June 1. They were harvested as follows: Plot 87, October 1; Plot 88, September 30; Plot 89, September 29; Plot 90, partly on September 28 and remainder on September 29; Plot 91, September 28.

May and June were rather cool months and hence would be favorable to the nitrate of soda. The mean temperature for May was 53.2 degrees, for June 56.0 degrees, July 63.5 degrees, August 60.1 degrees, and September 55.8 degrees. There were several cold nights with frosts in June. May 4 the thermometer went to 25 degrees, May 5 to 32 degrees, June 9 to 30 degrees, and June 28 to 31 degrees, and on this latter date there was quite a heavy frost so that it injured potatoes, not in these experiments but on some other plots at Aroostook Farm. The lowest temperature in July was 40. The lowest temperature in August was on the 28th when it was 35 degrees. It was, however, colder than this at some of the lower parts of Aroostook Farm, where there was a slight frost on the night of August 28. The rainfall for May was 2.74 inches, for June 4.80 inches, July 2.23 inches, and for August 2.35 inches, making a total of 12.62 inches during the growing months of 1914.

The tabulated results of the yields for 1914 follow.

Sulphate of Ammonia and Nitrate of Soda Experiment—1914. Yields of Potatoes.

TREATMENT	MERCHANTABLE		CULLS	
	YIELD		YIELD	
	Bbls.	Bush.	Bbls.	Bush.
87 ⅔ nitrate of soda	120.2	330.5	7.0	19.3
88 ⅔ sulphate of ammonia	110.3	303.4	11.0	30.3
89 ⅓ nitrate of soda ⅓ sulphate of ammonia	116.3	319.8	5.8	15.9
90 ⅓ nitrate of soda ⅓ organic	119.8	329.6	6.2	17.0
91 ⅓ sulphate of ammonia ⅓ organic	110.2	303.1	7.8	21.5

THE 1915 EXPERIMENT.

The experiment was repeated for 1915, using duplicate plots. There were no essential differences in the soil and treatment from those of 1914. The fertilizers were especially made by the same company and were applied at the same rate. The nitrate of soda for Plots 128 and 141 were not added to the fertilizer until used at planting.

The first series, Plots 128 to 132, were planted with Norcross potatoes. The duplicate plots, Nos. 141 to 145, were planted with Lowell Strain Green Mountain. The analyses of the fertilizers used, the dates of planting and harvesting and the yields are given in the tables that follow.

Sulphate of Ammonia and Nitrate of Soda Experiment—1915. Analyses of Fertilizers Used on the Different Plots.

PLOTS	NITROGEN				Available phosphoric acid %	Potash %
	As nitrate %	As ammonia %	As organic %	Total %		
128, 141	2.27	0.17	1.15	3.59	8.43	6.77
129, 142	0.12	2.34	1.20	3.66	9.20	6.59
130, 143	1.12	1.24	1.20	3.56	8.47	6.91
131, 144	1.14	0.18	2.22	3.54	8.50	6.88
132, 145	0.15	1.24	2.29	3.68	8.90	6.84

Sulphate of Ammonia and Nitrate of Soda Experiment—1915. Dates of Planting and Harvesting.

Plot No.	Date planted	Date harvested	Plot No.	Date plant	Date harvested
128	May 18, 1915	Sept. 28, 1915	141	May 22, 1915	Oct. 1, 1915
129	May 18, 1915	Sept. 28, 1915	142	May 22, 1915	Oct. 2, 1915
130	May 18, 1915	Sept. 28, 1915	143	May 22, 1915	Oct. 2, 1915
131	May 18, 1915	Sept. 29, 1915	144	May 22, 1915	Oct. 4, 1915
132	May 20, 1915	Sept. 29, 1915	145	May 22, 1915	Oct. 4, 1915

Sulphate of Ammonia and Nitrate of Soda Experiment—1915. Yields of Potatoes per Acre.

Plot No.	TREATMENT	Merchantable		Culls	
		Bbls.	Bush.	Bbls.	Bush.
128	⅔ nitrate of soda	107.4	295.4	10.2	28.1
141	⅔ nitrate of soda	118.9	326.9	3.2	8.8
	Average	*113.2*	*311.2*	*6.7*	*18.5*
129	⅔ sulphate of ammonia	117.4	322.9	5.8	15.9
142	⅔ sulphate of ammonia	121.5	334.1	5.9	16.2
	Average	*119.5*	*328.5*	*5.9*	*16.1*
130	⅓ nit. of soda, ½ sulphate of ammonia	113.0	310.8	5.7	15.7
143	⅓ nit. of soda, ⅓ sulpbate of ammonia	122.7	337.4	2.2	6.1
	Average	*117.9*	*324.1*	*4.0*	*10.9*
131	⅓ nitrate of soda, ⅓ organic	101.6	279.4	6.6	18.2
141	⅓ nitrate of soda, ⅓ organic	121.2	333.3	4.6	12.7
	Average	*111.4*	*306.4*	*5.6*	*15.4*
132	⅓ sulphate ammonia, ⅓ organic	99.2	272.8	9.8	26.9
145	⅓ sulphate ammonia, ⅓ organic	119.3	328.1	3.9	10.7
	Average	*109.3*	*300.5*	*6.9*	*18.9*

The mean temperature for May, 1915 was 49.5 degrees, for June 60.6 degrees, July 64.1 degrees, and August 61.8 degrees. During June the thermometer did not go below 36 after the second day and 45 was the lowest the thermometer went in July. The rainfall for May was 4.05 inches, June 1.95 inches, July 3.40 inches and for August 3.50 inches, making a total of 12.90 inches during the growing months of 1915.

In 1914 the sulphate of ammonia gave smaller yields than the nitrate of soda plots. In 1915 the sulphate of ammonia plots of the first series gave larger yields than the nitrate of soda plots and in the second series practically the same yields were obtained irrespective of whether the nitrogen was as nitrate or ammonia. June, 1914, was 4 degrees colder than June, 1915, and there were quite hard frosts up to the end of the month. This gave a poorer chance for the nitrifying organisms to render the sulphate of ammonia available. This may account for the reduced yields from the sulphate of ammonia in 1914. Plots 128 to 131 in 1915 were planted May 18. May 19 there was a rainfall of one and a half inches. While sulphate of ammonia is as easily dissolved in water as is nitrate of soda, it does not leach out of soil nearly as fast. It would seem, comparing the results from the first series with the duplicate series, that the heavy rain of the 19th carried off much of the nitrate of soda which reduced the yield because of the lack of available nitrogen thus brought about. The higher temperature (average of 4 degrees) of June 1915 over 1914 seems to explain the yields from the duplicate plots being practically the same with nitrate of soda as with sulphate of ammonia.

The average yields from the different test plots for the two years are given in the table on the page that follows.

It will be noted that for the two years the sulphate of ammonia plots have somewhat larger yields than those obtained from the nitrate of soda plots. The organic nitrogen does not appear to be as completely available as either that of the nitrate of soda or the sulphate of ammonia. This is in accord with earlier trials made at Houlton where the organic nitrogen seemed to delay the maturing of the crop, thereby decreasing the yield. Experiments of this kind can give conclusive results only after a number of years trials. This experiment is to be repeated in 1916.

Sulphate of Ammonia and Nitrate of Soda Experiment, 1914 and 1915.

Yield in Barrels Per Acre.

TREATMENT.	MERCHANTABLE.			TOTAL		
	1914	1915	Average	1914	1915	Average
3/3 nitrate of soda	120.2	113.2	116.7	127.2	119.9	123.6
3/3 sulphate of ammonia	110.3	119.5	114.9	121.3	125.4	124.5
⅔ nitrate of soda, ⅓ sulphate of ammonia	116.3	117.9	117.1	123.1	121.9	122.5
⅔ nitrate of soda, ⅓ organic	119.8	111.4	115.6	126.0	117.0	121.5
⅔ sulphate of ammonia, ⅓ organic	110.2	109.3	109.8	118.0	116.2	117.1

PREPARING LAND WITH DYNAMITE.

There has been extensive propaganda by the interested makers of dynamite as to its agricultural use. Trials were undertaken at Highmoor Farm in 1912 with dynamite in the field and in the orchard. The actual work of preparing the land with dynamite was under the direction of an expert sent out by one of the powder companies.

EXPERIMENTS WITH FIELD CROPS.

An acre and a half of land, the soil of which is fairly uniform, that was in pasture and apparently had not been in crop for twenty-five or more years, was made free from stone, divided into three uniform plots of a half acre each, and treated as follows in September, 1912: One-half acre was plowed and then sub-soil plowed. Another half acre, the middle one, was prepared by boring holes 30 to 36 inches deep a rod apart and discharging one-half pound stick of 20 per cent dynamite in each hole. The third plot was plowed in the usual way. The plan involved leaving the whole field to be treated alike each year to see if any difference could be noted in the resulting crops due to the three different methods of preparation.

The soil is the usual rather moderately heavy loam of Highmoor Farm which is underlain with a very difficultly penetrable sub-soil. In the spring of 1913 the whole field was plowed and the proper seed bed made for the planting of potatoes. The field was planted to potatoes in 1913, to corn in 1914, and to rape in 1915. Careful records were made during growth and at the time of harvest. There were no appreciable differences in the crop on the different plots.

This experiment seems to clearly indicate that under the soil conditions at Highmoor Farm there is no advantage whatever in the use of dynamite for loosening soil for field crops.

EXPERIMENT IN SETTING APPLE TREES.

Also in 1913 it was necessary to reset part of the Baldwin orchard. Part of these trees were set in the usual way, by digging holes in the spring with a spade, thoroughly mixing the soil and setting out as commonly practiced by orchardists, and part by loosening the soil by the explosion of sticks of dynamite in the fall of 1912 and setting the trees in the spring of 1913.

The soil on Highmoor Farm is a rather moderately heavy, reddish loam underlain with a very difficultly penetrable sub-soil. In the orchard in question the surface soil contains rather more sand, and is consequently somewhat lighter than on most of the farm. The sub-soil runs from 7 to 15 inches under the top soil. It is sandy but is "greasy" and will hold water, as the puddles show. Regardless of the presence of sand the sub-soil is very compact and impenetrable.

The topography is such in this orchard, for the most part a gentle slope to the west, that good, natural surface drainage is secured. The only pockets where water was likely to stand or where the surface drainage was poor have been underlain with tile.

In blowing holes for setting the trees the charge of dynamite was inserted at the depth of from 30 to 36 inches. The material encountered toward the bottom of the holes consisted of a very resistant hardpan which was very hard to break, therefore one stick of extra 20 per cent dynamite was used in each hole, instead of one-half stick as was originally planned. The expert reported as follows regarding a test hole put down to a depth of 36 inches and loaded with one cartridge: "This blew but a small amount of dirt out of the hole. A man was put to work digging out loose material, and we found that there was very satisfactory loosening to a depth of 36 inches with lines of breakage extending in all directions from the point of the shot. This was considered very satisfactory, so we proceeded to blast the other holes in like manner." In writing of digging into another hole on similar soil on another part of the farm he said: "This shattering seemed to lip slightly upward in all directions."

In the spring of 1913, 126 young Baldwin trees were set where the holes were blasted with dynamite the fall before. At the same time 52 other trees from the same lot and similar in every respect were set in the same orchard in the usual manner by digging the holes with a shovel. In both cases, whether dynamited or without, a large hole was dug and then filled with top soil to where the tree was to be set. This was necessary in both instances for the object of dynamiting was to shatter the sub-soil rather than to simply make a hole. Therefore, little or no hand labor was saved by the use of dynamite. So far as the location of the trees in the orchard was concerned, the conditions were ideal from an experimental standpoint. Since they were to replace trees which had been removed in different parts of the orchard for one cause or another chance rather than design determined where they should be placed. Consequently they were scattered indiscriminately through the orchard, and those which were dynamited or simply shovel dug were mixed in with each other without any particular order.

The primary object of the experiment was to see whether or not the trees would make a better or more vigorous growth where the subsoil had been shattered with dynamite. So far as could be judged no difference in this respect occurred as the result of growth in 1913 and 1914. In the spring of 1915 some rather unexpected, comparative results were obtained.

Good growth was made during both seasons and in the fall of 1914 all of the trees appeared vigorous and healthy. Early in the spring of 1915 it was evident that a considerable amount of winter injury had occurred, and that many trees were killed back to within 12 to 18 inches of the ground. Some of these, however, were killed nearly or quite to the soil line.

In the latter part of June, when it was felt that the full extent of injury would be apparent, the Station pathologist made a careful inspection of all of these Baldwin trees which had been set in 1913. The object of this inspection was to obtain accurate data as to the character and extent of the injury on each individual tree, simply as a matter of record. Up to the time of making this record he had only a very general knowledge of the dynamiting experiment and knew nothing of the plan followed with reference to the distribution of the dynamited and non-dynamited trees in the orchard.

In taking the record it was very evident that there was no relation between the location of individual trees in the orchard and the amount of winter injury observed, but some striking results were obtained when the observations were tabulated in comparison with method used in setting the trees. Out of 126 trees in holes previously dynamited 49 or nearly 39 per cent were either killed or badly injured. In the case of the 52 trees set in shovel dug holes only 4, or less than 8 per cent suffered in like manner.

No attempt was made or should be made to draw general conclusions from these figures obtained in this single orchard. What happened here might not occur under different soil conditions. Nevertheless, it is quite evident that the method of dynamiting followed is not adapted to setting trees in the soil on this individual farm. The use of dynamite the preceding fall in no way decreased the cost of setting the trees in the following spring. There was no greater growth where dynamite was used than where it was not. The losses from winter injury were 5 times greater where dynamite was used. Based on the results where the trees were set in shovel-dug holes the probable loss from winter injury among the entire 178 would be approximately 14 trees. Similarly had all the trees been set in dynamited holes, the expected loss would be about 69.

ARE SHEEP PROFITABLE IN MAINE?

The Station Council at its meeting in April, 1914, authorized the purchase of grade sheep sufficient to stock Highmoor Farm for the purpose of studying the question as to whether sheep can or cannot be profitably raised in Maine. The sheep were not to be pure bred or of fancy type. This was to preclude their being sold at high price because of breeding. Nor were they to be early bred to produce "hot house" lambs for the high price of the early market. They were to be just plain sheep such as any ordinary farmer could carry They were to be good grade stock, bred for wool and lambs. The income was to be from wool and meat sold and from the manure produced as a by-product. While care was to be exercised in handling the sheep, no high priced labor was to be used. Nor was a special "shepherd" to be employed.

ITEMS OF COST.

There will always be an expense for fitting up and maintaining pastures, buildings, etc., for sheep that will vary on different farms and with different farmers. The overhead charges, such as interest, taxes, and the like will also vary with varying conditions. In an experiment conducted by the Station, where it is necessry to keep individual records, buttons for the ears and time involved in note taking are expense items that the ordinary farmer need not be at. The cost of fencing the pastures, erecting shelters in the pastures, fitting up the barns for winter quarters, expenses for piping water, water troughs, sheep dipping tanks, shearing machine, root and feed cutters, rent of land for pastures and crops for the sheep, while necessary expenses that must be taken into account by the practical farmer, are omitted from this account. The items included are initial cost of sheep, cost of labor in care of sheep and growing crops for the sheep, cost of purchased food and allowance for hay and straw fed, the cost of dips and other medicines, and the cost of the seed for crops fed.

THE FLOCK.

The sheep were purchased from what is probably the largest sheep farm in New England. The proprietor is a great believer in sheep. And although he does not keep an at all accurate account of income and outgo on his sheep proposition believes them to be profitable. His interest in the proposed project at Highmoor Farm was one strong reason for its being undertaken. He sold to us 75 ewes and their lambs to be delivered in the early summer of 1914. These were to be grade Hampshire of two and three years of age. The lambs that were to come with them were to be sired by pure bred registered Hampshire bucks. The lambs with the ewes were, therefore, at least three-quarter Hampshire. It was stated that the ewes would probably average rather more than a lamb each. The whole selection of the stock was left by us to the owner and his shepherd. Three registered Hampshire bucks were purchased in the fall of 1914 from the same grower. The lambs of 1915 are from the ewes purchased. None of the 1914 lambs were bred that year.

The expenditures and receipts are shown in the tabulation that follows. The items are discussed beyond the table.

**Sheep Account for Year July 1, 1914, to June 30, 1915.*

Inventory and Expenditures.

75 ewes at $5	$375 00
55 lambs at $3	165 00
3 bucks at $25	75 00
Bran and middlings, 7,000 pounds	105 60
Oil meal and gluten meal, 900 pounds	15 95
Corn meal, 2,400 pounds	38 40
Ground oats, 54 bushels	28 60
Hay, 45,600 pounds	273 60
Straw, 6,000 pounds	15 00
Salt, 4 bushels	1 24
Rape and turnip seed for field planting	3 23
Tobacco, dips, etc.	27 46
Man labor on sheep and crops for sheep, 1,012 hrs.	180 10
Horse labor on crop, 19 hrs.	2 45
	$1,306 63

Receipts and Inventory.

Sheep and lambs sold	$127 25
Wool sold	158 62
Manure (estimated value when drawn to the fields)	24 00
67 old ewes on hand June 30, 1915	335 00
22 yearling ewes on hand June 30, 1915	110 00
42 ewe lambs on hand June 30, 1915	126 00
31 buck lambs on hand June 30, 1915	93 00
3 registered bucks on hand June 30, 1915	75 00
Loss on operation for year	257 76
	$1,306 63

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*Pasturage, use of land for crops and buildings for summer shelter and winter housing, interest on investment and other overhead charges are not included in this account.

EXPENDITURES.

The Cost of the Sheep. The sheep were shipped about the first of July and were unloaded from the cars the evening of the day they were loaded at the shipping point. There were 75 ewes and 55 lambs with them. The price paid was (including freight) $755.15 for 75 ewes, 55 lambs, and 3 registered Hampshire bucks. In order to bring the financial calculations to a comparable basis, the sheep are considered in the account as though they cost $5 each and the lambs $3 each, as that is the value the farm superintendent used in the 1915 inventory. The bucks are carried in the inventory at the price paid, deducting shipping charges. This depreciation in valuation has no bearing at all on the question of whether we did or did not pay a fair price for the sheep. It is merely to put the matter on a comparable basis. Some of the sheep were older than was agreed. One experienced handler of sheep claimed that a few of them were as old as 8 years. But as there is no way of telling a sheep's age after she is 4 the statement of the seller's shepherd that none of them was over 6 years old may be accepted. The oldest ewes have been replaced by the yearling ewes of our own raising. The sheep as sent were a good looking lot and have steadily improved under Highmoor Farm management and conditions.

The Food. The three pastures have about 100 acres. They are fenced with a very heavy wire fence that is dog-proof and nearly man-proof. They are well equipped with shelters and supplied with abundant water. They are adjacent to the fields where crops are grown to supplement the pasture in case of shortage. Rape is grown and fed by cutting or by pasturing, according to circumstances. Turnips are grown for winter feed. Only first quality hay is produced on the farm. There are no fine, light yielding grasses on the farm. Hence, hay must be valued at what hay is worth to sell. Probably no man who keeps a labor account would continue to grow June grass for hay, as keeping account of time and yields would show the high cost per ton of such hay.

About 95 sheep, lambs and bucks, were carried through the winter of 1914-15. They ate about 6 tons of grain and 23 tons of hay, which at cost for the grain and selling value of the hay at the barn, aggregated $477, or about $5 each. They were also fed some cull apples and the turnips that were grown on an acre and a half of land.

The seed for crops is for two years, and the labor includes the planting of the 1915 as well as the cost of the 1914 crops.

Disease and Parasites. The cost for dips is out of all proportion to what it will be in succeeding years. The sheep as received had a good many ticks and two dippings were necessary. They were cleaned up so thoroughly that careful examination failed to show a single tick this fall. During the year there were the usual parasitic troubles, but they were successfully handled without loss.

Labor. No labor is charged against the sheep except for time actually put in necessary care of the flocks, the pastures and the crops for the sheep. The farmer who does not keep a labor account has little notion of the large amount of time that is used in "chores." On both of the Station farms daily records and weekly reports are made of the time of all employees. From these records it is possible to tell exactly what each person was doing at any hour of any day. Most of the labor is for work of investigation in which labor cost cannot be taken into account. The sheep problem is the only one on farm management that has been undertaken. The study of the records on this experiment discloses, as it doubtless would on any other similar study, that labor is a very large item of expense. The labor cost for the year was about $2 a sheep.

Losses. There were two deaths that autopsies did not satisfactorily explain. There was little loss of lambs at lambing time. Not all of the ewes proved to be with lamb and these have been sold for meat.

RECEIPTS AND INVENTORY.

Sales. The wool, sheep and lambs sold were probably as well marketed as the average farmer could expect. No attempt to market in any unusual way was attempted as that would have been contrary to the plan of the experiment.

Manure. The plant food in the feed consumed was worth at usual fertilizer values in the neighborhood of $200. It may be that the farm superintendent underestimated the value of the sheep manure, and that it was worth more than is credited. It is not the fault of the sheep if faulty handling of the manure results in loss. The manure was left under the sheep during the winter as is customary with all handlers of sheep the writer has knowledge of in the East or the Middle West. It is commonly supposed that the compacting of the manure and the moistening from the liquid excretions will prevent losses. From our experience this seems more than doubtful. The present year (1915-6) it is proposed to know the exact value of the manure. For this purpose a water tight, covered manure receptacle has been built and the manure will be moved to this monthly. Swine are being kept on the manure. A financial account is being kept with swine. The manure will be sampled and analyzed when hauled to the fields. In this way it is hoped to give an exact credit value to the manure for 1915-6.

The Inventory. The sheep are in excellent condition. The increase in flock for 1915 is very good—something more than a lamb to a ewe.

Summary. The cost of the operation for the year 1914-5 was $1,306.63. The sales and inventory aggregated $1,048.67. The total loss without any consideration of overhead charges, depreciation of plant, rent of land, interest on investment, or taxes that a farmer would pay, was $257.76, or about $3.45 for each of the old ewes.

CRITICISM OF THE EXPERIMENT.

The flock has been visited at times by experts who have expressed themselves pleased with the sheep and the way they are handled. Helpful suggestions have been constantly sought. When it was found that the operation for 1914-5 had been at a loss a statement was sent to leading sheep men for criticism and suggestions. Later practically the same statements were given wide circulation through publicity letters. An attempt by the help of the Station Directors and Commissions of Agriculture of the New England States was made to learn if there were any people in New England keeping sheep on at all large scale that knew they were making a success of the business. A few were found who were supposed to be making money from sheep husbandry but none of these had kept account of the cost of labor and of home-grown food consumed.

Thus far no criticisms have come to our attention that point out reasons for failure other than those outlined in the publicity letter and in this article. Were it not for the fact that the balance is on the wrong side of the account the Station would feel content with everything in the experiment other than the care of the manure. The sheep have done well and look well. Comparisons with exact feeding experiments made at other places indicate that the cost of feed is not greater than is to be expected with purchased food. There are few data relative to labor costs in sheep feeding experiments.

THE EXPERIMENT IS BEING REPEATED.

It is recognized that there were a number of things that interfered with the success of the trial. For this reason the loss for 1914-5 was charged off and the whole experiment started over again, without prejudice, July 1, 1915. The older sheep were disposed of, the yearling lambs are bred to registered sires, and enough of the ewe lambs were kept to replace the ewes that should be removed another year. These are all inventoried at meat prices. Barring accidents, there would seem to be no reason why the sheep will not have the best possible chance to make good this year.